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1

㊺医用穿刺管の超音波誘導式刺入装置

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図面の簡単な説明

第1図、第2図は本発明の実施例である。第1図は超音波振動子外装式医用穿刺針の縦断図、第2図は超音波振動子内装式医用穿刺針の縦断図。

発明の詳細な説明

本発明は通常用いる医用穿刺管(例えば穿刺針、カテーテル、ゾンデ等)を体深部に位置する特定の動脈、静脈、およびリンパ管等の脈管、およびこれらに関連ある臓器に対して鋭い指向性をもつ超音波ビームを利用して体表面よりの深さおよび方向を測りながらきわめて正確に刺入、または接近させることを目的とするものであつて、本発明にかかる医用穿刺管(例えば穿刺針)はその外側(第1図)、或いは内側(第2図)に固定または着脱可能なる支持具の先端部にきわめて小型の超音波振動子(例えばチタン酸バリウム製)を装着したものであり、更に振動子励振用の高周波発信器および受信器を組みあわせた装置である。

近年脳、心臓、腹部臓器および四肢等の病的変化を見出すために、脈管特に動脈または静脈に穿刺管(例えば穿刺針、カテーテル、ゾンデ等)を刺入して造影剤を注入しつつX線撮影を行ういわゆる脈管撮影法が重要な検査法として用いられている。しかしながら体深部に位置する脈管(特に動脈)を体表面から深さと方向とを決定して正確に穿刺するには高度の技術が要求され、且不完全なる穿刺のまま造影剤を注入したる場合脈管の破裂又は閉塞或いは造影剤の漏出のために近接して存

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在せる神経組織等の損傷を来たし、そのために患者を死に到らしめることも稀でない。本発明はこの確実なる穿刺を可能にするものである。

次に本発明の穿刺針の誘導刺入法の原理とその実施方法について説明する。本発明にかかわる装置を用いて皮膚面より体深部に向けて一定周波数の連続超音波ビームを発射すると、もしその超音波ビーム内に例えば血管が存在したる場合にはその血管内を流れる血球の移動、或いは血流の乱れ或いは血管壁の拍動により発射波はドップラー効果をうけて発射波と周波数を異にする反射波を得ることが出来る。この反射波を超音波振動子にて電気的信号に変換したる後、発信信号と合成検波することにより両者の差の電気的信号を得ることが出来る。これを増幅した後スピーカー等に導くことにより一種の唸り音として聴取することが出来る。例えば発信周波数を5Mc/s とした場合、一般に動脈からの唸り音は殆5000c/s 以下で心臓周期と共に音調が変化する可聴音であり、静脈からの唸り音は2000c/s 以下の心臓周期と一致しない可聴音である。且、これらの唸り音は超音波ビームが対象脈管の断面の中心に向つた場合に最大の音量となり、且、この超音波ビームが対象脈管に対しごく僅かでもはづれれば突然消滅する。更にビーム中にあつても移動する部分を持たない組織からの反射波、或いはビームからはづれた近接部位からはドップラー効果による唸り音を聴取することは出来ない。従つて穿刺針と超音波振動子とを組み合わせ、超音波振動子より鋭い指向性をもつ超音波ビームを穿刺針の穿刺方向に発射して目標脈管からの反射波を絶えず受信しながら最大の音量が得られる様に穿刺針を誘導刺入することにより容易、且、確実に目標脈管等に接近または穿刺することが出来る。

しかしながら極めて細い脈管或いは体表面より極めて深部に位置する脈管からの反射波は極めて弱いため受信した後、そのままで発射波と合成検

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波しても十分なる唸り音を検出しえないが、発信周波数のみを減衰させる回路を受信器に挿入することにより反射波を相対的に大きくした結果となり、強い唸り音を得ることが出来る。

更に、近年脳外科において頭蓋内血管腫、動脈瘤等の破裂による出血を予防するための治療法として、開頭後、脳組織を排除した後、脳の深部にある血管を結紮、或いは補強するという手術が行われているが、手術そのものによる生命への危険の発生または重篤なる後遺症を残す可能性が大である。本穿刺針をかかる症例に適用すれば直径数㎜の孔を頭蓋骨にあけ、その孔より頭蓋内にこの穿刺管を挿入し、血管よりの唸り音を指標として穿刺針を病変部位に到達せしめその周辺に血管壁補強用の樹脂を注入するという極めて侵襲の少い方法にて血管或いは動脈瘤の破裂を防止することが出来る。

以上の如く本装置を使用することにより安全且確実に目標脈管または脈管に関連せる臓器を穿刺またはその附近に穿刺管を到達させることが出来るため確実な診断を容易にするとともに、更に高度の特殊な治療を行うことが可能となる。

次に図面により本穿刺針の構造を説明する。

第1図は、穿刺針1の外側に超音波振動子2および振動子保持器3をくみあわせたものである。従つて超音波ビームは穿刺針を取り囲む様に、且

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穿刺針の縦軸方向即ち、穿刺方向に発射される。

第2図は穿刺針1の内側に抜去可能なる超音波振動子2および振動子保持器3を組みあわせたものであり、超音波ビームは、穿刺針の管内より穿刺方向に発射される、目標に接近したる後、或いは穿刺したる後に超音波振動子および保持器のみを抜去し、弁5にて抜去孔を閉じると同時に薬剤注入管6への連絡孔7を開く様にしたものである。尚4は振動子励振用電流の送信及び受信用端子である。

(57)特許請求の範囲

1　超音波のドプラ効果による検出信号を指針として脈管への穿刺管の刺入または接近を誘導する装置において、穿刺管1に固定または着脱可能に取付けた支持器3に超音波ビームが穿刺管の軸方向に送波されるように超音波振動子2を装着すると共に、穿刺管1に接続して薬剤注入管6を装備したことを特徴とする医用穿刺管の超音波誘導式刺入装置。

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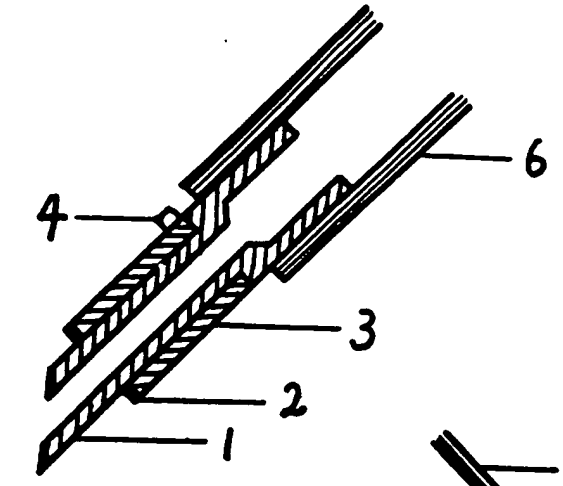
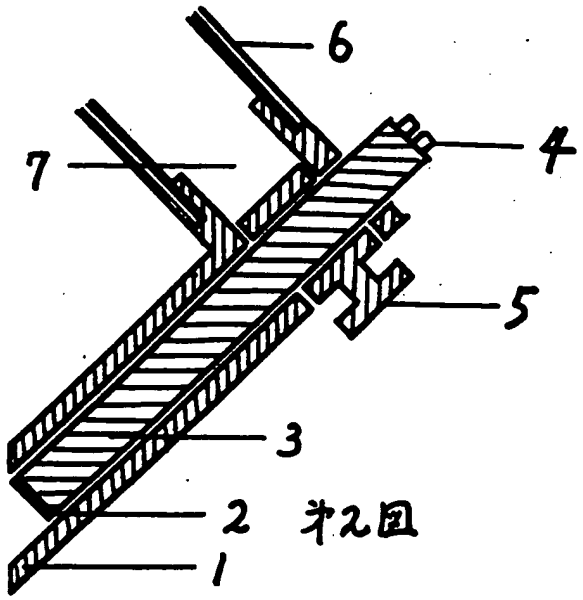
第817頁　第831～2頁　日刊工業新聞社発行



第1図



第2図

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(54) **An Ultrasonic Guide-type Insertion Apparatus for a Medical Paracentesis Tube**

(21) Application No. 42-34045
(22) Filing Date: May 29, 1967
(72) Inventor: Same as applicant
(71) Applicant: Haruo Omizo
(74) Agent: Sadamichi Imamura, Patent Attorney

Brief Description of the Figures

Figures 1 and 2 are practical examples of the present invention. Figure 1 is a vertical cross section of an outside-mounted ultrasonic oscillator type of medical paracentesis needle. Figure 2 is a vertical cross section of an inside-mounted ultrasonic oscillator type of medical paracentesis needle.

Detailed Description of the Invention

The objective of the present invention is to extremely accurately insert or bring close a commonly used medical paracentesis tube (such as a paracentesis needle, a catheter, a probe, or the like) while measuring the depth and direction from the surface of the body by utilizing an ultrasonic beam that has acute directivity with respect to specific arteries, veins, lymph ducts, and other such ducts located deep within the body, as well as to organs that are related to these. The medical paracentesis tube (such as a paracentesis needle) of the present invention is put together such that an extremely small ultrasonic oscillator (made, for example, of barium titanate) is mounted on the tip of a fixed or removable support on the outside (Figure 1) or the inside (Figure 2) of this tube, which also has a high-frequency emitter and receiver for use in oscillator excitation.

Vasal photography, in which a paracentesis tube (such as a paracentesis needle, a catheter, a probe, or the like) is inserted into a duct, and particularly an artery or a vein, and roentgenography is performed while injecting a contrast agent in order to discover any unsound changes in the brain, heart, abdominal organs, limbs, etc., has come into use in recent years as an important examination method. However, sophisticated technology is needed to determine the depth and direction from the surface of the body of ducts (particularly arteries) located deep within the body, and to then perform accurate paracentesis, and if the contrast agent is injected with improper paracentesis, damage to or blockage of the duct or leakage of the contrast agent can injure the nerve tissue, etc., that is present in the surrounding area, which not infrequently can even lead to the death of the patient. The present invention permits this paracentesis to be performed accurately.

The principles of the guiding and insertion of a paracentesis needle of the present invention will now be described along with the method of implementation thereof. When the apparatus of the present invention is used to emit a continuous ultrasonic beam of a specific frequency from the skin surface toward the interior of the

body, if, for instance, any blood vessels are present within this ultrasonic beam, the emitted wave undergoes a Doppler effect due to the movement of the corpuscles flowing through these blood vessels, disturbances in the blood flow, or the pulsation of the vascular wall, so that a reflected wave that has a different frequency from that of the emitted wave can be obtained. After this reflected wave has been converted into an electrical signal with an ultrasonic oscillator, synthetic detection of the emitted signal allows an electrical signal of the difference of the two [waves] to be obtained. After this has been amplified, it can be sent to a speaker or the like to produce a type of buzzing sound that can be detected by ear. When, for instance, the emission frequency is 5 Mc/s, the buzzing sound from an artery is generally about 5000 c/s or less and is an audible sound in which the tone varies with the cardiac cycle, while the buzzing sound from a vein is 2000 c/s or less, and is an audible sound that is not synchronized with the cardiac cycle. These buzzing sounds reach their maximum volume when the ultrasonic beam is directed toward the center of the cross section of the artery in question, and suddenly cease if the ultrasonic beam strays from the artery in question only ever so slightly. Further, the reflected wave from tissue that has no moving portion cannot be heard even if the tissue is in the center of the beam, nor can the buzzing sound resulting from a Doppler effect from nearby members that are out of the line of the beam. Consequently, a paracentesis needle can be inserted into or brought close to the targeted duct, etc., both easily and accurately by combining the paracentesis needle with an ultrasonic oscillator, emitting from an oscillator an ultrasonic beam that has acute directivity, and then guiding the paracentesis needle so as to obtain the maximum volume while constantly receiving the reflected waves from the targeted duct.

However, since the reflected waves from extremely narrow ducts or from ducts that are located at an extremely great depth from the surface of the body are exceedingly weak, unless steps are taken, no buzzing sound can be detected adequately if a synthetic detection with the emitted wave is performed, but inserting into the receiver a circuit that attenuates only the emission frequency results in the reflected waves being made relatively larger, so that a strong buzzing sound can be obtained.

Further, an operation in which blood vessels deep within the brain are ligated or reinforced after performing a craniotomy and after the brain tissue has been removed has been performed in recent years as a treatment method used for preventing hemorrhaging due to the tearing of an arterial knob, etc., or an endocranial hemanglioma in neurosurgery, but this operation can itself be life-threatening, and there is a great possibility that serious after-effects will remain. When the present

paracentesis needle is applied to a case, the tearing of blood vessels or arterial knobs can be prevented with a method in which there is extremely little invasion, wherein a hole of several millimeters in diameter is made in the skull, the paracentesis needle is inserted into the cranium through this hole until it arrives at the diseased member using the buzzing sound from the blood vessel as an indicator, and a resin used fro reinforcing the vascular wall is injected into the surrounding area.

The use of the present apparatus as described above allows a paracentesis tube to be inserted into or brought close to the targeted duct or an organ related to a duct both accurately and safely, which facilitates accurate diagnosis and also allows highly specialized treatments to be performed.

The structure of the present paracentesis tube will now be described while referring to the figures.

Figure 1 shows the ultrasonic oscillator 2 and the oscillator retainer 3 assembled on the outside of the paracentesis tube 1. Therefore, the ultrasonic beam is emitted in the direction of the vertical axis of the paracentesis tube, i.e., the paracentesis direction, so as to encircle the paracentesis tube.

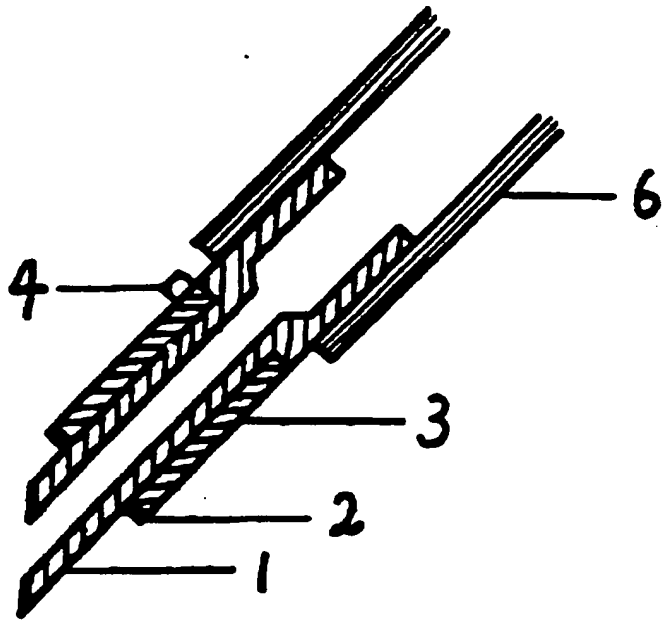
Figure 2 shows the removable ultrasonic oscillator 2 and oscillator retainer 3 assembled on the inside of the paracentesis tube 1. Here, the ultrasonic beam is emitted in the direction of paracentesis from within the tube, and after drawing close to or puncturing the target, only the ultrasonic oscillator and the retainer are removed, and simultaneously with the closing of the removal hole with the valve 5, the connecting hole 7 to the drug injection tube 6 is opened. Finally, 4 is the sending and receiving terminals for the current used in the excitation of the oscillator.

(57) Claims

1 An ultrasonic guide-type insertion apparatus for a medical paracentesis tube, which is characterized by the fact that, in an apparatus that inserts a paracentesis tube into, or guides it close to, a duct using as an indicator a detection signal that results from a Doppler effect of ultrasonic waves, the ultrasonic oscillator 2 is mounted to the support 3, which is attached in a removable fashion or fixed to the paracentesis tube 1, such that the ultrasonic beam is sent in the axial direction of the paracentesis tube, and the drug injection tube 6 is mounted so that it is connected to the paracentesis tube 1.

(56) Cited Publications
Handbook of Ultrasonic Technology (New Revised Edition), October 31, 1966, p. 817 and pp. 831 to 832, published by Nikkan Kogyo Shinbun-sha.

Figure 1



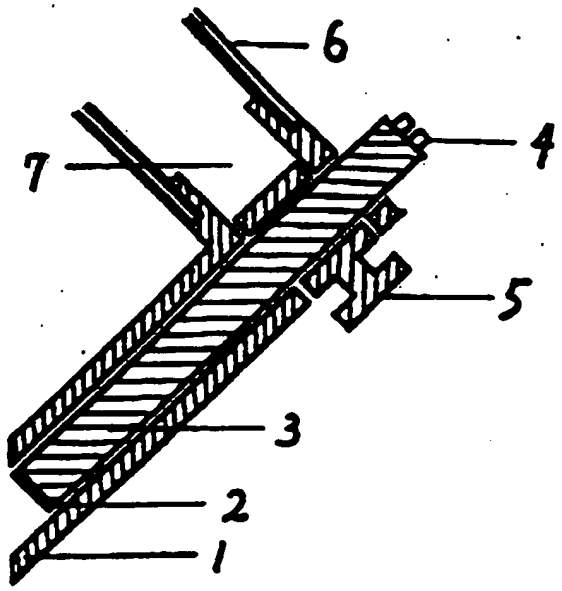


Figure 2